TRANSDUCER APPARATUS COMPRISING TWO MEMBRANES

FIELD OF THE APPLICATION

[0001] The present invention relates to a transducer apparatus. The invention further relates to, but is not limited to, a transducer apparatus for use in mobile devices.

BACKGROUND OF THE APPLICATION

[0002] Many portable devices, for example mobile telephones, contain a number of acoustic transducers, such as microphones, earpieces and speakers. Such transducers are key components in mobile phone audio/acoustic design. Generally, there will be one or more sound channels or back cavities associated with each acoustic transducer. Such sound channels can ensure a certain frequency response is obtained for the transducer, and must be carefully designed as part of the mechanical configuration of the device hardware. Small changes in the size and configuration of the sound channels or cavities can have a large effect on the acoustic properties of the combined transducer/sound channel.

[0003] In known acoustic transducer configurations, the mechanical design of the sound channels is fixed at the point of hardware design and manufacture of the device is completed, and cannot be later adapted during use for a specific purpose or desired configuration. Instead, the desired acoustic properties are produced by filtering the electrical signal representing the sound output before the signal is applied to the transducer. Typically, this requires the use of significant processing power, commonly provided by dedicated digital signal processors (DSPs).

[0004] Furthermore there is a limit to the modification of the acoustic response of the transducer which can be carried out in the DSP.

[0005] An example of the limitations of the mechanical design of typical microphone transducers is that of wind noise. Wind noise is a problem particularly for miniaturised designs such as found in mobile phone where there is no room for mechanical protection of the microphone from wind such as used in broadcast microphones like wind screens or foam protectors. Furthermore filtering out the wind noise from the signal in the electrical domain requires significant processing power in a digital signal processor, typically produces poor results as the sound pressure levels generated by the wind cause the microphone acoustic element to saturate, and also filters wanted signals where the filter is set to a wide frequency range.

STATEMENT OF THE APPLICATION

[0006] It is an aim of at least some embodiments of the invention to address one or more of these problems.

[0007] According to a first aspect there is provided an acoustic transducer comprising: at least two membranes; and at least one adjustable coupling configured to adjustably couple oscillations between a first membrane and a second membrane of the at least two membranes.

[0008] The at least one adjustable coupling may comprise at least one of: at least one adjustable mechanical coupling; at least one adjustable hydraulic coupling; and at least one adjustable pneumatic coupling.

[0009] The acoustic transducer may further comprise a controller configured to determine at least one characteristic of the oscillation from the first membrane and control the at least one adjustable coupling dependent on the characteristic.

[0010] The characteristic of the oscillation may comprise at least one of: maximum amplitude of the oscillation; energy of the oscillation; and frequency distribution of the oscillation.

[0011] The adjustable coupling may be configured to decouple oscillations between a first membrane and a second membrane of the at least two membranes.

[0012] The second membrane may be configured to directly receive a sound pressure wave from the exterior of the acoustic transducer.

[0013] The at least one adjustable coupling may comprise: a volume of air between the first membrane and the second membrane; and an adjustable valve configured to seal, partially seal or open the volume of air.

[0014] The acoustic transducer may further comprise an acoustic transducer support structure configured to locate the first and the second membrane and define the volume of air between the first membrane and the second membrane, wherein the adjustable valve is defined by the acoustic transducer support structure and one of the first and second membranes.

[0015] The at least one adjustable coupling may comprise: a volume of liquid between the first membrane and the second membrane; and an adjustable valve configured to seal, partially seal or open the volume of liquid.

[0016] The at least one adjustable coupling may comprise at least one rotational coupling rod configured to selectively rotate to a first position to physically couple the first membrane to the second membrane, and to a second position to physically decouple the first membrane to the second membrane.

[0017] The at least one adjustable coupling may comprise at least one scissor coupling member.

[0018] The at least one scissor coupling member may be configured to at least one of: selectively open to physically couple the first membrane with the second membrane, and selectively close to physically decouple the first membrane with the second membrane; and selectively operate in a rigid open position to physically couple the first membrane with the second membrane, and in a loose open position to relatively decouple the first membrane with the second membrane.

[0019] The at least one adjustable coupling may comprise at least two adjustable couplings configured to be controlled separately.

[0020] The at least one adjustable coupling may comprise an adjustable coupling with a coupling gain greater than one.

[0021] According to a second aspect of the application there is provided a method comprising: providing in an acoustic transducer at least two membranes, wherein at least one of the first and second membranes are suitable for providing an acoustic wave response value; and adjustably coupling oscillations between a first membrane and a second membrane of the at least two membranes.

[0022] Adjustable coupling may comprise at least one of: adjustable mechanical coupling; adjustable hydraulic coupling; and adjustable pneumatic coupling.

[0023] The method may further comprise: determining at least one characteristic of the oscillation of at least one of the first membrane and second membrane; and controlling the coupling dependent on the characteristic.